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ABSTRACT

Growing interest in adult literacy has encouraged research and innovative programming in the field. This paper examines several pieces of software created by the Institute for the Study of Adult Literacy at Pennsylvania State University and explains their underlying conceptual foundations and the integration of visual materials. The Penn State Adult Literacy Courseware uses a whole-word approach to teach reading, and has been field tested at 46 sites, with impressive gains in reading achievement. "R.O.A.D. (Real Opportunity for Advancement and Development) to Success" is a course of interactive computer software and print-based materials to help drivers develop the reading skills needed to study and pass the national commercial driver's examination. "Daybreak" helps adults obtain or progress in entry-level jobs by assessing basic skills and diagnosing strengths and weaknesses. "Blue Shield" is being designed to produce a comprehensive industry-centered model basic skills program for entry-level Blue Shield of Pennsylvania workers. "A Day in the Life..." is courseware for low-level readers that simulates actual projects in a worker's day. Software has also been designed as job-related literacy training for American Telephone and Telegraph (AT&T). Particular theoretical concepts used in these pieces of software are reviewed, including organization and design factors. Twenty-four figures illustrate sample computer screen displays. (Contains 23 references.) (SLD)

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Integrating Visual Imagery Into Workplace Literacy Computer Software

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by
Brett Bixler and John Spotts

Overview

Illiteracy is an issue of critical national and international concern. The results of illiteracy are alarming: many adults in the U.S. are unable to participate fully in our democratic, social, and economic systems because of illiteracy (Harman, 1985). Economically, more than 200 billion dollars are spent each year on welfare, prisons, lost productivity, and the like. Even more important is the impact of illiteracy upon the quality of life for those individuals. A functionally illiterate person cannot participate fully in society and make independent decisions as a worker, citizen, parent, and consumer. Internationally, illiteracy is a key issue in economic development and in building the foundation for a free world. No matter how valiant the efforts are to "conquer illiteracy," the reality is that it is too complex and deeply embedded a phenomenon to be easily eradicated.

Current adult literacy instructional programs reach only a small percentage of those in need. Dropout rates from programs are as high as 50 percent; program evaluation is virtually nonexistent. Instruction is performed in many instances by volunteers who receive approximately 10 hours of training. Instructional materials in some cases are reworks of the content of children's curricular materials, thus making it even more difficult to motivate adults to participate. Literacy service providers, both professional and volunteer, have made enormous positive strides against these odds. Individual lives have been changed and enriched as a result. However, in a field without adequate funding, with teachers who are trained to work only with children, with little research to improve practice, and with embryonic systems of networking, the enormity of the problem simply outweighs volunteer efforts.

It is ironic that despite these massive efforts to provide literacy instruction, a sound conceptual and research base has been lacking. Accordingly, valuable resources are sometimes expended for programs and projects that cannot be generalized to other settings. Lacking common understanding about the nature and extent of illiteracy, funding and

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providing agencies alike are limited in their ability either to learn from the experiences of other programs or to report with accuracy the effectiveness of their own programs. To increase the effectiveness of current and future efforts to reduce illiteracy, a need exists for sound conceptual and research foundations oriented to the information and competence of adult learners.

Growing interest in adult literacy has encouraged the recent development of research studies and innovative programming in the field. In 1985, the College of Education at Penn State established the Institute for the Study of Adult Literacy as a vehicle for using the resources of a major land grant institution to address issues related to adult literacy. The Institute is nationally recognized for its work in literacy research, development, and dissemination activities. The Institute's mission stresses the importance of connecting research to improving practice. Each research project results in a practical application in the field, including staff development activities, curriculum and instructional materials development, policy recommendations, and dissemination of research findings through Institute publications, professional publications, and presentations.

The Institute for the Study of Adult Literacy is unique in its triple purpose:

1) Development and dissemination of a sound conceptual and research base in the field of adult literacy;
2) Improvement of practice in the field of adult literacy; and
3) Leadership and coordination of a comprehensive approach to the delivery of adult literacy services.

Institute projects to date have addressed the following interrelated issues in adult literacy:

1) computer-based instruction
2) workplace literacy
3) family literacy
4) staff development and training
5) special needs populations
6) customized materials development.

A great deal of theoretical research has been incorporated into the design process of the computer-assisted instruction (CAI) the Institute created. Results of numerous research studies reveal that individuals in adult literacy studies increase their test scores and/or grade-level equivalency through the use of CAI (Imel, 1989). Recent software projects at the Institute incorporate the apprenticeship learning model with computer simulation activities. This paper will examine several pieces of software created by the Institute and explain their underlying conceptual foundations and integration of visual materials.

Penn State Adult Literacy Courseware

In the fall of 1984, development of adult literacy software began at Penn State University. The result of this first major software development effort was The Penn State Adult Literacy Courseware. It is designed to help

adult beginning readers expand their word recognition.

After two years of development, the courseware was field tested in 1986-87 at 46 sites in Pennsylvania using Chapter I sites. Chapter I teachers offered reading and writing instruction using the Penn State Adult Literacy Courseware to instruct the low-literate parents of Chapter I children. At the time, it was the only research project investigating the effects on children when an intervention strategy is used with their parents. The empirical results are impressive; most of the test subjects had gained more than one reading grade level after 20 hours of instruction. (Askov, Maclay, & Bixler, 1986).

This courseware uses a "whole word" approach to teach 1,000 high-frequency and functional words. The goal is expanded word recognition for adult beginning readers. The courseware is interactive, branching and responding to the user's answers and needs. The courseware records learner responses and progress on an individual learner data disk.

Reading vocabulary is divided into four categories: picturable words, non-picturable words, words frequently found on application forms, and words based on high-frequency spelling patterns. These are further divided into groups of approximately 10 words each which form lessons. In all of the modules, the words are taught in context using a speech synthesizer to present multiple-choice and completion exercises to practice recognition of the target words. Word outlines are employed to increase word recognition. The courseware uses branching to permit review and reinforcement. An elaborate record keeping system records and analyzes responses, number of attempts and response time. A file editor allows the instructor to monitor a learner's progress as well as enter new material to supplement the courseware.

The courseware begins with a unit on computer usage (Module 1) designed to acquaint the learner with the speech synthesizer, the commands and the letter/number keys.

Picturable words (Module 2) teaches 250 words. These words are introduced with a graphic (see Figure 1).

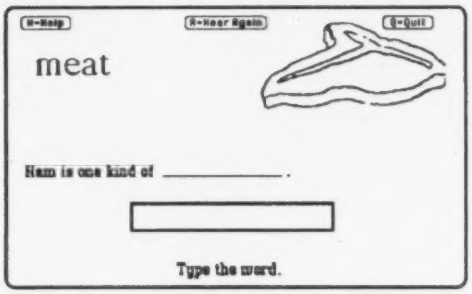


Figure 1
Module 2 Example Screen

Non-picturable words (Module 3) teaches 440 words which are introduced using short selections on a variety of topics. Both of these modules include games to reinforce the acquisition of new vocabulary. Computerized pretests and posttests are also found in these modules. The learner is pretested before each lesson with 90 percent set as mastery level. If mastery is not attained, the learner is directed to the instruction and games to

help him/her learn the vocabulary. The teacher also has the option of including only selected vocabulary words in the instructional sequence. The learner is posttested upon completion of a lesson. Five forms of each test exist.

Module 4 teaches 140 words commonly found on application forms of all types. The learner practices this vocabulary by filling in an application form with his/her own data, which may be printed as a reference.

Module 5 teaches 170 words which are based on high-frequency phonograms. This module gives practice in word building with consonants being added before 16 common word patterns (such as "ake").

Module 6 (a word processing module) allows the learner to use the words s/he is learning in writing activities. This module is used concurrently with the other modules. In addition, Modules 3 and 6 are customizable by the teacher to include other words and sentences.

R.O.A.D. to Success

Federal legislation mandated that as of April 1, 1992, all commercial vehicle drivers must pass an actual driving exam and a written test to be able to keep or obtain a commercial vehicle driver's license. The written test is designed at a 6th to 9th grade reading level. The intent of the legislation is to increase highway safety, but it has as unintentionally imposed a mandatory 6th to 9th grade reading level on public and private drivers.

The Commercial Driver's License (CDL) exam determines if veteran drivers across the United States will keep their jobs. Approximately five million drivers hold a commercial license nationally. If many of the equipment operators fail the CDL exam, the impact on the economy would be considerable. National trucking associations are projecting a severe shortage of qualified commercial drivers during the 1990s. In fact, the *Pennsylvania Occupational Information System: Labor Demand-Supply Relationship Component (1988)* predicts severe shortages in the transportation industry by 1995. Denying a functionally illiterate but experienced driver a job is not a solution to highway safety.

R.O.A.D. (Real Opportunity for Advancement and Development) to Success is a course of interactive computer software and print-based materials designed to help drivers develop the reading skills needed to study for and pass the national Commercial Driver's License exam.

R.O.A.D. to Success provides approximately 100 hours of instruction at a 4th grade reading level, using two different but parallel methods of delivery. One method uses computer-assisted instruction (CAI) and the other uses traditional classroom instruction. Both methods teach the same content using delivery tools that are appropriate for that medium. Both methods of instruction are designed to stand alone, but a learner is able to switch from one to the other with little

difficulty because of the identical content in the two approaches.

The courseware and print materials are based on the study manual produced by Essex Corporation, the company that developed the CDL exam. The materials are written at a 4th- to 7th-grade readability level to help drivers master vocabulary and reading skills they need to understand the manual and test.

R.O.A.D. to Success provides instruction for large vehicle operators on the following topics:

- General Knowledge
- Transporting Passengers
- Air Brakes
- Combination Vehicles
- Hazardous Materials
- Tank Vehicles
- Double/Triple Vehicles

Graphic materials incorporated into *R.O.A.D. to Success* are highly content-specific to the concept taught. Graphics range from a simple truck outline to a complex tractor-trailer air brake system (see Figures 2 and 3).

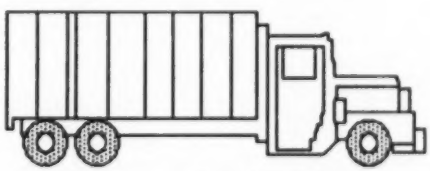


Figure 2 — Truck outline

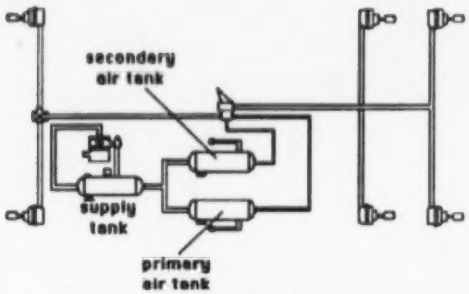


Figure 3 — Air brake system

Daybreak

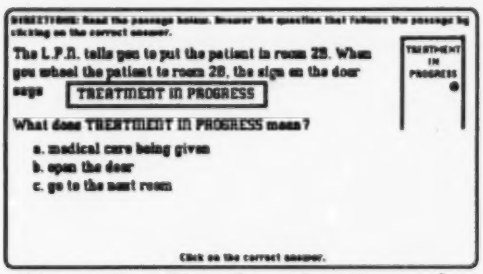
Many adults training for entry-level jobs don't have realistic expectations of the basic skills required to perform those jobs, or know whether their own basic skills are up to par. *Daybreak* helps adults obtain or progress in entry-level jobs by assessing related basic skills in a particular job area and diagnosing their strong and weak basic skills areas. This diagnosis enables the teacher/tutor to provide instruction in those weak areas. Improving job-related basic skills is the keystone of efforts to help adults find or advance in entry-level jobs.

Daybreak is designed for adults reading at about 4th- to 8th-grade levels. The software requires little computer sophistication. Adult learners can run through the program on their own after a few minutes of instruction on the use of the computer.

The courseware is job-specific; it allows adults to assess their basic skills in the context of the job area they wish to enter. Because every specific job cannot be analyzed for the basic skills required, the courseware addresses an array of job-related basic skills,

targeted at under prepared adults who have entry-level jobs or who aspire to entry-level jobs. The five occupational areas the courseware addresses are: health care, retail trade, administrative support, food service, and maintenance.

Through computerized examples of problems workers encounter on the job, learners can explore the job area they wish to enter and assess their basic skills in the context of that field. Explanations are given immediately for incorrect answers, providing opportunities for learning during the assessment. Graphics are limited to those relevant to the current question. For example, questions assessing the comprehension of a sign include a graphic of the sign; questions about forms include a graphic of the form itself (see Figures 4 and 5).


The L.P.N. tells you to put the patient in room 28. When you wheel the patient to room 28, the sign on the door says
TREATMENT IN PROGRESS
What does TREATMENT IN PROGRESS mean?
a. medical care being given
b. open the door
c. go to the next room
Click on the correct answer.
Figure 4 — Sign Question Example

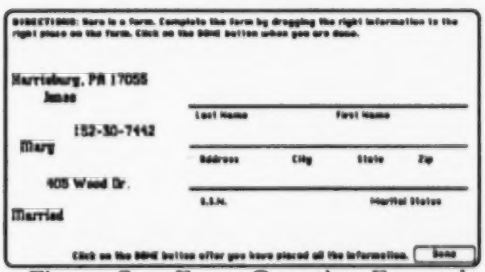


Figure 5 — Form Question Example

Blue Shield

This software is being designed to produce a comprehensive, industry-centered, model basic skills program to provide entry-level Blue Shield of Pennsylvania workers and trainees with the basic skills necessary to succeed in the workplace. Because the project focuses on the basic skills needed in claims preparation and processing, the curriculum and materials produced will be useful to other medical insurance industries across the United States. The model curriculum and materials will be especially useful to the overall network of various Blue Shield-owned companies.

The skills targeted in the course will also provide the basis for employees' upward mobility in the workforce. Blue Shield supervisors report a growing need for employees who are adaptable, especially relating to the use of technology, and adept at problem solving. The proposed training will address these needs and provide the training support needed to further the employment possibilities for Blue Shield entry-level workers.

The course, developing basic skills using content specific to the medical insurance industry, will include computer-based instructional materials, assessment instruments, and an instructor's guide.

The software uses a real-life scenario, or task approach. The learner must accomplish the given task, utilizing appropriate resources such as forms, manuals, dictionaries, etc.

Instruction is always available to assist the learner. The controlled use of graphics is confined to just what is needed to accomplish the task. In one module, the learner must read several different medical forms and answer relevant questions about each form (see Figure 6). When reading forms, the forms themselves are available on the computer. In another module, the learner must update a manual with new information. The manual is on the computer for this module. The student is encouraged through rehearsal strategies involving visual feedback to locate quickly the appropriate information field.

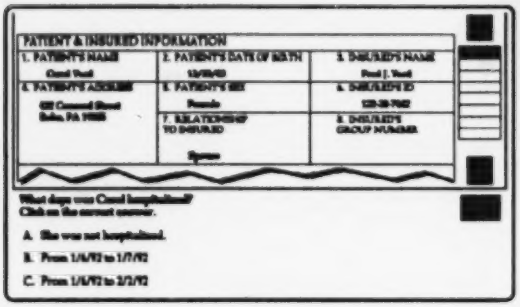


Figure 6 — Forms on the computer

A Day in the Life . . .

This courseware is designed for low-level (grades 3 to 7) readers. Using this courseware, learners perform actual projects encountered in "a day in the life" of a worker. *A Day in the Life . . .* is divided into six modules of instruction. Module 1 teaches the learner how to use the computer. Modules 2 through 6 teach the most common basic skills required for the food services, health, maintenance, retail, and clerical job areas. The five different career modules allow learners to choose the job that most interests them.

Each job area is divided into several scenarios, or tasks, the learner must accomplish. In Module 4 (maintenance), for example, one of the scenarios is "Paint a Room." Within a scenario, the learner must maneuver through the environment (by use of a map), acquire the objects necessary to accomplish the task, read and fill out the proper forms, perform the task, etc. (see Figure 7).

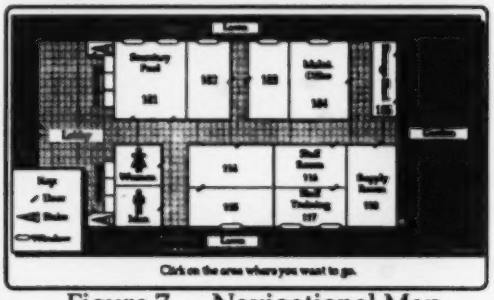


Figure 7 — Navigational Map

If the learner is stuck along the way, s/he can obtain a variety of help, including a full lesson on whatever is giving him/her difficulty. As this software is a simulation of real-life occurrences, critical thinking skills are needed, in addition to the literacy skills the learner must learn. This software is rich with graphics. Each "scene" the learner visits is designed to look as real and as three-dimensional as possible (see Figure 8).

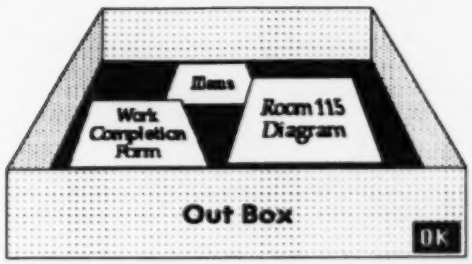


Figure 8 — Three dimensional graphic

The learner can examine, close-up, many objects, like manuals, cash registers, etc. Icons, or small pictures representing a single action the user can take by activating them, are used throughout the courseware (see Figure 9).

Figure 9 — Icons

Learner data disks provide detailed printouts of each learner's performance on assigned job tasks. This simple management system pinpoints areas where learners are encountering difficulty. The learner's progress is keyed to a basic skills list, which allows the teacher to decide easily those subjects the learner needs to master.

AT&T Software

This software implements a job-related literacy training program that prepares adults for telephone sales and customer service jobs in the private and public sectors. The training program, called the *Telephone Sales & Customer Service Training Program*, will teach job-related basic skills to people lacking the skills they need to qualify for telephone sales and customer service jobs.

The software looks at four different types of jobs: working for a telephone company; working for a credit card company; working for a bank; and working for an insurance company. Each job classification is divided into information sharing, simple customer contact, complex customer contact, and sales.

This software borrows many of the concepts used in *A Day in the Life . . .* courseware. Learners must accomplish a variety of tasks, which are presented through visually rich scenarios. In Information Sharing for a telephone company, for example, a "virtual computer" is modeled on the screen (see Figure 10).

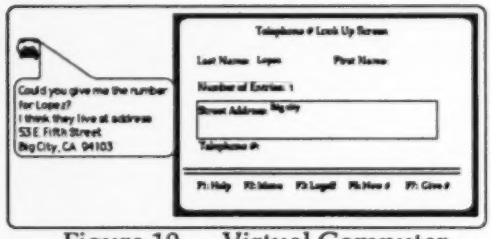


Figure 10 — Virtual Computer

Learners see the virtual computer screen and interact with it, as well as receiving instruction and prompts from the real computer. The task is to give the customer a telephone number, using information the customer provides to look up that number in the virtual computer's database. Other scenarios follow a similar format.

Theoretical Concepts Used in Institute for the Study of Adult Literacy Software

Institute for the Study of Adult Literacy software or courseware is designed to assist low-literate adult learners in obtaining basic literacy skills. The software presents each concept on highly visual screens, which include interactive activities designed to enhance learning (Gay, 1986; Carey, 1990).

Institute for the Study of Adult Literacy software uses the *functional context approach* to instruction. Research in the 1980s indicated that functional context instruction—instruction using the context of relevant work or life tasks—is effective in improving basic skills for the workforce (American Society for Training and Development, 1989; Sticht, 1987). Workplace literacy programs have been among the most prominent examples of functional context education in the field of adult literacy.

Functional context methods of instruction are especially effective and valuable for at least two reasons:

- Like on-the-job training, functional context instruction centered around work-related skills is clearly relevant to the adult learner's life. Thus, functional context instruction is a motivating factor. Harman (1985) suggests that "hard-to-reach" adults are best reached in programs where literacy is not the main goal but a tool to reach other goals. Functional context instruction has more intrinsic value to the learner (Sticht, 1987).

- With prior job knowledge and life experience, workers can read and interpret job-related materials several grade levels higher than they can read non-job-related materials (Mikulecky & Ehlinger, 1986). This because the terminology is familiar and the concepts are those worked with daily. Thus, if a program aims to improve work-related literacy skills, it would be counterproductive for learners to work with generic materials when they could be working at a higher level with job-related materials.

The Institute's software, using the functional context approach, teaches and reinforces the specific literacy skills needed by using the content of the job area as a basis for all instruction (Lajorie & Lesgold, 1989). The learners see the relevance of the instruction and are able to learn and retain the information better because it relates directly to their on-the-job experience. It capitalizes on their background knowledge from work experience, and enables them to improve their reading comprehension with familiar materials.

The design and development of the Institute's software is based on well-established current learning and psychological theories incorporated into an interactive computer-assisted instructional environment (Tennyson, 1990). Following is a description of key instructional components in the Institute's software:

• The Institute for the Study of Adult Literacy's software is written knowing that adult learners are different and unique in their needs (Baker & Bixler, 1990). Software needs of pre-adults differ from those of the adult population, which is trained and retrained. Adult learners are extremely goal-oriented. The software reflects the requirements of employers of a given locale (Zahniser, Long & Nasman, 1983). It also reflects the perceived needs of the learner.

• The organization of instruction is visually appealing to keep the learner's attention (Hannafin & Peck,1988). An graphic artist is used to establish aesthetically pleasing screen layouts (see Figure 11). The instructional designer assures the content "flows" from one concept to the other.

Figure 11 — Quality art

• Screens are "sparse" in terms of content density wherever possible. A segment of instruction is broken into small, discreet steps presented sequentially (Baker & Bixler, 1990). This results in screens with a great deal of white space (an area free of information). Instead of diversifying the learner's attention, the screens are clutter-free, allowing the learners to concentrate on the concept intended. Unnecessary distracters are removed from the screen. Illustrations are chosen and properly placed to make the text more meaningful and reduce the burden of details in the text (Dwyer, 1978). When teaching a concept about trucks, for example, if the graphic was a truck and several cars, the cars are removed from the graphic unless they are essential to the instruction (see Figure 12). Use of simple line drawings without any extra detail, shading, or fill patterns enhances the concept.

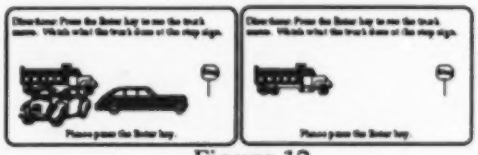


Figure 12
Removing unnecessary visual distracters

• The Institute for the Study of Adult Literacy's software uses large text sizes for text wherever possible (Baker & Bixler, 1990). Most text in books and magazines is 10 or 12 point. The Institute's software uses at least 14 point text. Ideally, an 18 or 24 point size is used because learners may have a visual impairment. The use of large text sizes also limits the amount of information placed on one screen.

• Directions and help are constantly provided (Baker & Bixler, 1990). One element many low-literate adult learners share is a difficulty in following directions. Directions are always visible or easily accessible. Learners are prompted step-by-step through difficult exercises. Mirrored prompts are used whenever possible. An example of mirrored prompts is having a set of directions at the top of the screen with an additional "What do I do next?" prompt at the bottom of the screen (see Figure 13).

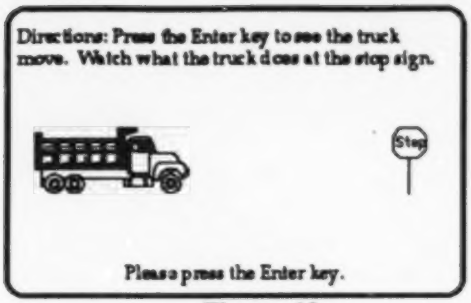

Directions: Press the Enter key to see the truck move. Watch what the truck does at the stop sign.
Stop
Please press the Enter key.

Figure 13
Example of mirrored prompts

• Placement of directions and graphics on the screen are consistent wherever possible (see Figure 14). The learner-computer interface is critical. Common phrases for all directions are used. Graphics appear in the same general area on the screen in sequential exercises where new graphics may replace old graphics. All menus, interactions, etc. that a learner must do to use the program successfully are standardized. Even literate people have difficulty with an inconsistent interface. Providing an explicit organization increases the memorability of new material (Bower, 1970).

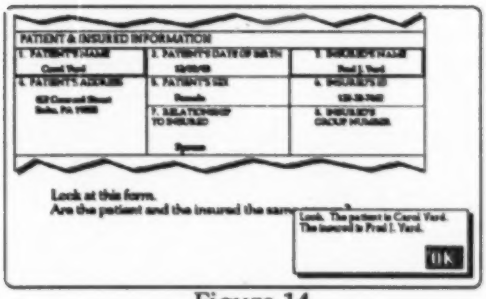


Figure 14
Consistent Feedback Placement

• Title screens (see Figure 15) notify the learner when a new section is being presented (Murray, 1989).

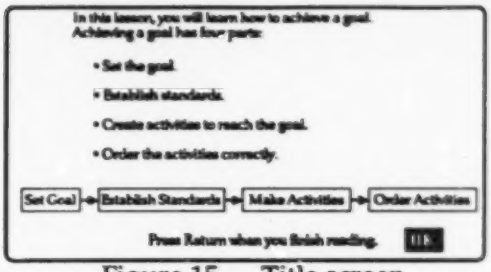

In this lesson, you will learn how to achieve a goal.
Achieving a goal has four parts:
• Set the goal.
• Establish standards.
• Create activities to reach the goal.
• Order the activities correctly.
Set Goal
Establish Standards
Make Activities
Order Activities
Press Return when you finish reading.
OK

Figure 15 — Title screen

• Summary screens (see Figure 16) inform the learner that a section is finished. Summary screens also organize and provide a synopsis of the material presented. Summary screens often mirror a title screen, occurring after completion of a section of instruction.

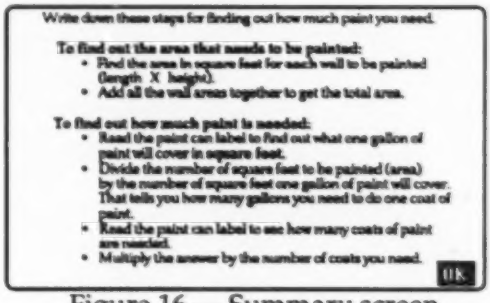

Write down these steps for finding out how much paint you need.
To find out the area that needs to be painted:
• Find the area in square feet for each wall to be painted (length X height).
• Add all the wall areas together to get the total area.
To find out how much paint is needed:
• Read the paint can label to find out what one gallon of paint will cover in square feet.
• Divide the number of square feet to be painted (area) by the number of square feet one gallon of paint will cover. That tells you how many gallons you need to do one coat of paint.
• Read the paint can label to see how many coats of paint are needed.
• Multiply the answer by the number of coats you need.
OK

Figure 16 — Summary screen

• All content presented in the software is accompanied by visual cues (Hayes & Henk, 1986; Bean, Singer, Sorter, & Frazee, 1986) to enhance learning (see Figure 17).

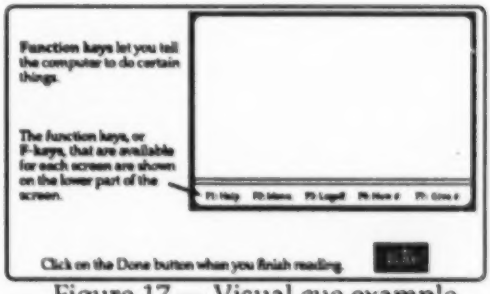

Function keys let you tell the computer to do certain things.
The function keys, or F-keys, that are available for each screen are shown on the lower part of the screen.
Click on the Done button when you finish reading.

Figure 17 — Visual cue example

• A variety of learner-control features are provided on each screen (see Figure 18), allowing the learner to select numerous learning or support options.

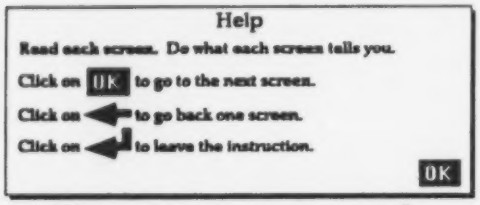

Help
Read each screen. Do what each screen tells you.
Click on OK to go to the next screen.
Click on to go back one screen.
Click on to leave the instruction.
OK

Figure 18 — Learner controls

Icons, or small pictorial representations of an action the learner can take are available at all times. When the learner activates the icon, the corresponding action takes place. Thus, the Institute's software is learner controlled and individualized (Gay,1986). These features are as follows:

- A "notebook" (pull-down word processor) feature is available for the learner to keep notes for later reference (see Figure 19). The learner may print out the entries made. The teacher may also use this notebook as a writing diagnostic tool.

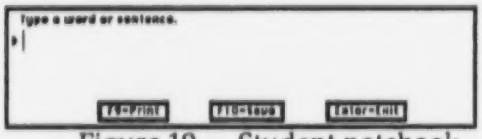


Figure 19 — Student notebook

- A "navigation" feature allows the learner to browse forward or backward from screen to screen (see Figure 20).

Figure 20 — Browse icon

- The Institute's software features on-line help in order to support the learner throughout the program. By selecting this option, the learner can choose to receive help on how to use the computer system or help with the functions and features of the Institute's software.

- The Institute's software contains a built-in dictionary which a learner can access at any time (see Figure 21). It shows the word, provides the definition of the word, and uses the word contextually in a sentence.

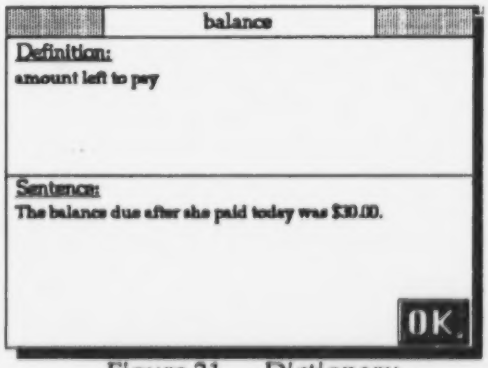


Figure 21 — Dictionary

- The learner can quit the Institute for the Study of Adult Literacy software at any time (see Figure 22). To insure the learner did not accidentally select the quit option, a pop-up window appears in order to verify the learner's request before quitting the program. An electronic "bookmark" allows learners to return to where they left off when they start the next session.

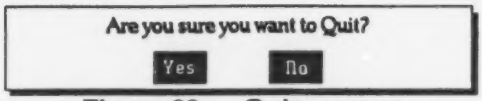


Figure 22 — Quit prompt

- In scenario-based activities (where the learner must accomplish one or more real-life tasks), when learners select the "learn" feature, they are provided a variety of interactive activities that are related to the learning concept being presented (Hamburger & Lodger, 1989) on the screen (see Figure 23).

Figure 23 — User learning option

• The assessment tracking system built into the Institute for the Study of Adult Literacy's software tracks the pathways taken by the learner (i.e., whether the learner chose to review the information screens alone or information screens and activity screens). The tracking system also allows the program to inform the learner of what materials to review before proceeding, whether the learner should partake in the learning activities, and whether the learner should seek outside assistance. Thus, the Institute's software offers metacognitive guidance (see Figure 24).

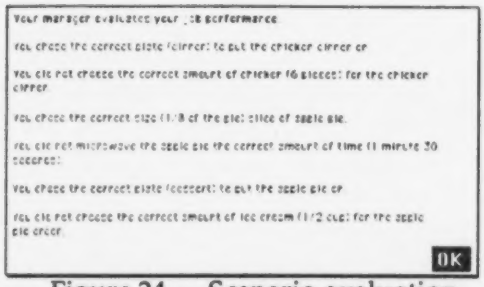


Figure 24 — Scenario evaluation

Conclusions

The simulated apprenticeship learning environment acts as a bridge between the theoretical learning of conventional learning and the actual practice of the work environment (Resnik, 1987). Computer simulations provide a real-world learning environment for the learner to apply many skills that are taught using known and proven learning theories. Imagery in the simulations plays an important role in assisting the learner to combine certain processes, such as spatial and cognitive processes, with the visual processes used in recalling tasks (Robertson & Lamb, 1991).

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